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(54) A method for producing propellant charges and charges produced according to this method.

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Description

TECHNICAL FIELD

The present invention relates to a method for producing propellant charges for cannons in which the propellant acts, in the ignition phase as tubular propellant sticks of considerable length in relation to the diameter of its inner combustion channels, but, on continued combustion, acts as a loosely disposed tubular grain propellant of short length, which results in charges which expose the barrel to a relatively slight degree of wear. The present invention also makes possible the production of charges of extremely high charge weight. The present invention also relates to charges produced according to the method as disclosed above.

BACKGROUND ART

In this art, it has always previously been considered extremely difficult to combine high charge densities of propellant charges with the best possible burning properties of the charge. Charges have long been manufactured from bundled one- or multi-perforated propellant sticks in full charge length, i.e in which each propellant stick is as long as the entire charge and in which the sticks are packed together in parallel to form dense bundles. The ignition of such a charge presents no problem. On the contrary, such ignition is readily effected along the channels and outer sides of the propellant sticks as long as these are not coated with inhibitor. However, practically all of the propellant combustion will, in such a charge, take place in the cartridge chamber of the weapon, or in its immediate vicinity, which gives rise to extreme local wear on the barrel. Moreover, the pressure which the combustion gases give rise to within the long propellant tubes must be prevented from becoming so high that the propellant tubes, after a certain burn time, are split throughout their entire length and shattered into small fragments. In such an event, this gives rise to a relatively large instantaneous increase in the burning surface of the powder, which may result in a very high pressure elevation in the barrel which, in its turn, may naturally have disastrous effects upon the barrel itself. The holes or channels in the propellant tubes for such charges must, therefore, be made quite large, thus reducing the possibility of attaining high charge density and, in addition, reducing the progressivity of a multi-perforated propellant.

One attempt to avoid the eff cts bri fly outlined above is disclosed in DE-C-135 102 and in its US-equivalence US-A-650 567, dating from 1900, in which the inventor Gathmann propos s providing multihole, tubular propellant rods of long length with venly spaced sidewardly provided cuts which breach the lengthwise channels of the propellant rods. Said cuts being provided in order to resist the tendency of the propellant rods to fly into small disoriented fragments by the internal pressure during its combustion. Such cuts will, if they have the V-shape shown on the drawings of DE-C-135 102, work more as gasoutlets than as weakening points intended to decide where the propellant rods should be broken up by the internal pressure. Other types of cuts are however also suggested but not shown in DE-C-135 102.

Several different types of propellant rods with open perforations passing through all of their longitudinal channels are also know from DE-C-127 968.

However, we have long been aware of the fact that propellant charges consisting of loose tubular or rod-shaped propellant divided up into short lengths - so-called grain powder most often impart to the charge the most highly advantageous burning properties and at the same time cause the least barrel wear. The reason for this is that loosely disposed powder in the propellant charge for cannons will, on combustion of the charge, in the main accompany the propellant gases and the projectile out into the barrel during successive combustion. This makes for considerably lower levels of local wear on the barrel in the critical zone immediately ahead of the charge chamber. At the same time short lengths of the propellant obviate the problems of fragmentation of the propellant tubes and consequential undesirable pressure peaks in the barrel. On the other hand, a desired pressure elevation in a charge of loosely disposed powder may be controlled, to a favourable point in time during the combustion process, by selecting single- or multi-perforated propellant of suitable hole diameter, possibly supplemented with a surface inhibition provided in a per se known manner. The disadvantage inherent in the loosely disposed grain powder is its considerable bulk and space requirement, since each grain of powder will then lie randomly oriented. Moreover, such loose powder charges require long ignitor tubes, or other types of igniting agents, extending along at least a portion of the charge and ensuring an instantaneous total ignition throughout a major part of the charge.

Otherwise, it is conceivable that the overall ignition of the charge will be unev n due to the high and uneven resistance to gas flow between the Powder grains. In view of the desir to be able to produce propellant charges of the same charge density as that which can be attained using bundled tubular propellant sticks of full charge length, but with the same burn properties as those which ar attained in charges of loosely disposed tubular or rod-shaped granular propellant divided into

smaller lengths, attempts have been made in this art to produce charges in which powder of the latter type has mor or less manually been stacked, side by side, in layers one above the other. These charges have, admittedly, functioned satisfactorily, but they are extremely expensive to produce manually and extremely difficult to produce by machine. Another method of increasing the performance of artillery pieces without recourse to a new design with room for larger propellant charges would then be to change to a propellant of higher force which, in its turn, automatically increases the level of wear on the barrel in a manner which is often unacceptable.

We have, however, now discovered a particularly advantageous method for the production of propellant charges in which the propellant powder, on initiation, acts as a tubular propellant of large length in relation to the diameter of the combustion channel, quite simply because it then consists of such a propellant, but, after a brief interval in the continued combustion process, acts in the same manner as rod-shaped or tubular granular propellant divided up into short lengths, quite simply because it then consists of such granular propellant. The very fact that these charges may, moreover, be made with extremely high charge weights is a further advantage.

The solution to the problem has proved to be to form the charge of mutually parallel, tightly packed, single- or multihole tubular propellant rods, which, prior thereto, have been provided, at predetermined separations, with from its outside without the removal of any material transversally effected perforations, which have sufficient width to pass through all combustion channels of the propellant tube and which leave a certain amount of propellant intact on either side of the perforations.

The perforations according to the invention will, at the moment of initiation, function as localised weak-points in the propellant tubes, rather than as gas outlets. The result will be that, because of the inner excess pressure of the combustion gases, the propellant tubes will, at a very early stage, become fragmented and thus form a grain propellant of a predetermined configuration. The weakening at each perforation must, therefore, be sufficiently large for the propellant tube to break completely at the perforations rather than become split along the propellant combustion channels. A suitabl spacing between these perforations has been found to be between 10 and 100 tim s the inn r diameter of the propellant tubes, i e the diameter of the combustion channels. Since each perforation should cover all longitudinal channels in the tubular propellant which may, for example, have 1-, 7-, 19- or 37-holes, or som other suitable number of channels, it is a distinct advantage to provide the p rforations in such a manner that a sufficient amount of propellant is left on eith r side of the perforations in order that the propellant tube retain a sufficient inherent rigidity so as not to break up during both forming and handling of the charge. In propellant tubes of a length exceeding 100 times the diameter of their combustion channels, measures must be taken to ensure that the propellant tubes, on initiation, do not become fragmented in an uncontrolled manner. This problem may, in certain cases, occur even when powder tubes are of a length which is just above 10 times the diameter of th combustion channels. The propellant length which, in each individual case, gives rise to such uncontrollable combustion must thus be consider d as excessive in this context. Thus, the term tubular propellant of considerable length in relation to the diameter of the combustion channels is here taken to mean lengths in excess of between 10 and 100 times the diameter of the combustion channels. One result of the dense packing of the propellant which we have succeeded in achieving in this way is that we have been able to pack wear-reducing "Swedish additive" in a modification of one of our older charges without needing, by compensation, to reduce weapon perfomance or increase th force of the propellant. On the contrary, the modified charge displays considerably better performance, whilst the wear-reducing additive has reduced barrel wear in a highly satisfactory manner.

The perforation of the tubular propellant rods may readily be executed in conjunction with the final shaping of the propellant by extrusion through a die. An automatic device for perforating the propellant tubes at predetermined separations can be provided in conjunction with the outlet side of the die, or elsewhere. In conjunction herewith, means for surface inhibition of the propellant tubes may be incorporated in those cases where it is desirable to produce a surface inhibited propellant with increased progressivity. Propellant charges according to the invention, wholly or partly consisting of surface-inhibited, progressive propellant are thus easy to produce. In this context, the present invention is highly relevant to this art, since a surface-inhibited propellant requires, as a rule, high charge rates in order to he fully effective. Charges of this type which have been subjected to tests have also proved to function highly satisfactorily. The surface inhibition may, d pending upon the inhibitor, the coating method tc, be effected either befor or after the perforation.

BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS

Th present invention has been defined in the appended claims and will now be described in

greater detail below with reference to a number of drawings.

In the accompanying drawings:

Fig 1 shows an oblique projection of a rosetteshaped, tubular propellant rod perforated with 7 holes;

Fig 2 is a cross-section at one of the perforations through the propellant rod according to Fig 1;

Fig 3 shows a perforation through a cylindrical 19-hole propellant rod;

Fig 4 shows a finished charge on another scale;

Fig 5 illustrates a general arrangement for producing perforated propellants according to the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to the drawings, on which corresponding parts have been given the same reference numerals irrespective of the different scales on the figures, reference numeral 1 indicates a perforated 7-hole propellant in which the longitudinal propellant channels are designated 2 and the perforations are designated 3. As has already been pointed out, the perforations entail that no propellant material whatsoever has been removed. The perforations 3 may be better described as through incisions, each of which cover all of the 7 longitudinal combustion channels 2 of the tubular propellant but leave a certain portion 4, 5 of the tubular propellant walls intact on either side of the incision (see Fig 2). Fig 3 shows a corresponding perforation through a cylindrical 19-hole propellant.

The charge illustrated in Figh 4 consists of number of perforated tubular propellant rods 1 of full charge length which have been bundled together by means of combustible bands 6 and which may, for example, be passed down into a case or provided with a surrounding powder bag. If desired, the charge may also be provided with a base initiation charge 7 and be supplemented with outer protection 8.

Finally, Fig 5 shows a general apparatus for producing perforated, surface-inhibited tubular propellant. The figure shows a screw extruder 9 provided with a matrix or die 10 through which the finished propellant 1 is extruded. Immediately after the extruder, there is a device 11 for surface inhibition of the propellant by a suitable substance, followed by a second device for perforating the tubular propellant at predetermined separations. Perforation of the entire length of the tubular propellant may also be affected by simultaneous use of a plurality of cooperating perforators.

Claims

1. A method of producing propellant charges for cannons in which the propellant, on initiation, functions as a tubular propellant (1) with interior combustion channels (2) of large length in relation to the diameter of said combustion channels (2) thereof, but on continued combustion, functions as loosely disposed tubular or rod-shaped so-called granular propellant divided into shorter lengths, comprizing that the propellant charge is formed by the parallel binding of suitable forms of single- or multihole tubular propellant rods (1) of large length in relation to the diameter of the combustion channels (2), said rods having, prior thereto, been provided, at predetermined separations with perforations (3) from the outside of the propellant tube (1) reaching all of its longitudinal combustion channels (2) **characterized** in that each perforation (3), without the removal of any propellant material, is effected transversally through the propellant tube (1) and is of a sufficient width to pass through all of the longitudinal combustion channels (2) in the propellant tube (1).

2. The method as claimed in Claim 1, **characterized** in that the perforations (3) of the propellant rods (1) are executed in such a manner that a sufficient total amount (4,5) of propellant is available on either side of the perforations to maintain the unity of the propellant tube, while this amount of propellant is, at the same time, nowhere of such thickness that breaking at the weakened points in the tube is superseded by complete shattering of the walls.

3. The method as claimed in one or more of Claims 1 or 2 **characterized** in that the perforation (3) of the propellant is effected in conjunction with the production of the tubular propellant by extrusion in a matrix or die.

4. The method as claimed in one or more of the Claims 1-3 **characterized** in that the perforations (3) are effected at separations which corresponds to between 10 and 100 times the diameter of the longitudinal combustion channels of the propellant tubes.

5. A propellant charge produced by the method according to any of the Claims 1-4, comprizing a plurality of densely, parallel packed single- or multi-hole tubular propellant rods (1) with interior combustion channels (2) of large length in relation to the diameter of said combustion channels (2), in which each tubular propellant rod at a distance corresponding to between 10 and 100 times the diameter of the combustion

channels (2), is provided with perforations (3) which cover all of the combustion channels (2) of the propellant tube, said perforation being effected without the removal of any propellant material **characterized** in that said perforations (3) are effected transversally through the propellant tubes and with a sufficient width to pass through all the longitudinal combustion channels in the propellant tube and with a certain amount of propellant (4,5) intact on either side of the perforations.

Revendications

1. Procédé de fabrication de charges de propergol destinées à des canons, dans lesquelles le propergol, lors de l'amorçage, se comporte comme un propergol tubulaire (1) ayant des canaux internes (2) de combustion de grande longueur par rapport au diamètre des canaux (2) de combustion mais, lors de la poursuite de la combustion, se comporte comme un propergol granulaire en forme de barreaux ou tubulaire non tassé divisé en courts tronçons, la charge de propergol étant formée par liaison en parallèle, de forme convenable, de tiges tubulaires (1) de propergol à un ou plusieurs trous et ayant une grande longueur par rapport au diamètre des canaux de combustion (2), les tiges ayant préalablement été munies, à des distances prédéterminées de séparation, de perforations (3) partant de l'extérieur du tube (1) de propergol et atteignant tous ces canaux longitudinaux (2) de combustion, caractérisé en ce que chaque perforation (3), sans extraction de matière du propergol, est formée transversalement au tube (1) de propergol et a une largeur suffisante pour passer dans tous les canaux longitudinaux (2) de combustion présents dans le tube (1) de propergol.

2. Procédé selon la revendication 1, caractérisé en ce que les perforations (3) des tiges (1) de propergol sont réalisées de manière qu'une quantité totale suffisante (4, 5) du propergol soit disponible des deux côtés des perforations pour que le tube de propergol garde son unité, alors que la quantité de propergol n'a nulle part une épaisseur telle que la cassure aux points de faiblesse du tube soit remplacée par un écartement complet des parois.

3. Procédé selon une ou plusieurs des revendications 1 et 2, caractérisé en ce que la perforation (3) du propergol est réalisée avec la fabrication du propergol tubulaire par extrusion dans une matrice ou filière.

4. Procédé selon une ou plusieurs des revendications 1 à 3, caractérisé en ce que les perforations (3) sont réalisées avec des distances de séparation qui sont comprises entre 10 fois et 100 fois le diamètre des canaux longitudinaux de combustion des tubes de propergol.

5. Charge de propergol réalisée par mise en oeuvre du procédé selon l'une quelconque des revendications 1 à 4, comprenant plusieurs tiges tubulaires (1) de propergol à un ou plusieurs trous, tassées parallèlement de manière dense, et ayant des canaux internes (2) de combustion de grande longueur par rapport au diamètre des canaux (2) de combustion, dans laquelle chaque tige tubulaire de propergol comporte, à des distances comprises entre 10 fois et 100 fois le diamètre des canaux (2) de combustion, des perforations (3) qui recouvrent tous les canaux de combustion (2) du tube de propergol, la perforation étant réalisée sans enlèvement de matière du propergol, caractérisée en ce que les perforations (3) sont réalisées transversalement dans les tubes de propergol, avec une largeur suffisante pour qu'elles passent dans tous les canaux longitudinaux de combustion formés dans le tube de propergol alors qu'une certaine quantité de propergol (4, 5) reste intacte de part et d'autre des perforations.

Patentansprüche

1. Verfahren zur Herstellung von Treibladungen für Geschütze, in denen das Treibmittel bei Zündung als rohrförmige Treibladung (1) mit inneren Verbrennungskanälen (2) von im Verhältnis zum Kanaldurhmesser großer Länge, und im weiteren Verlauf der Verbrennung als lose angeordnetes röhrchen- oder stäbchenförmiges, in kürzere Abschnitte unterteiltes, sog. Treibladungsgranulat wirkt, wobei die Treibladung durch paralleles Bündeln von geeignet geformten Ein- oder Mehrlochstäben (1) von rohrförmigem Treibmittel mit im Verhältnis zum Verbrennungskanaldurchmesser großer Länge gebildet wird und die Stäbe vorher an vorgegebenen Trennstellen mit Perforationen (3), die von der Außenseite des rohrförmigen Treibmittels zu sämtlichen longitudinalen Verbrennungskanälen reichen, versehen wurden, **dadurch gekennzeichnet**, daß jede Perforation (3) ohne Entfernen von Treibladungsmaterial quer zu dem Treibmittelrohr ausgebildet wird und eine so große Breite hat, daß sie durch sämtliche longitudinalen Verbrennungskanäle (2) in dem Treibmittelrohr (1) läuft.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß die Perforationen (3) der Treibmittelstäbe (1) derart ausgeführt werden, daß an beiden Seiten der Perforationen eine ausreichende Gesamtmenge (4, 5) Treibmittel verfügbar ist, um den Zusammenhalt des Treibmittelrohres (1) beizubehalten, während gleichzeitig diese Treibmittelmenge an keiner Stelle so dick ist, daß anstelle eines Bruches an den Schwachstellen des Rohres ein vollständiges Zersplittern der Wände eintritt.

3. Verfahren nach einem oder mehreren der Ansprüche 1 oder 2, dadurch gekennzeichnet, daß die Perforationen (3) des Treibmittels in Verbindung mit der Herstellung der rohrförmigen Treibladung durch Strangpressen in einer Matrize oder einer Form ausgebildet werden.

4. Verfahren nach einem oder mehreren der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß die Perforationen (3) an Trennstellen ausgebildet werden, die zwischen 10 und 100 Mal dem Durchmesser der longitudinalen Verbin- brennung dungskanäle der Treibmittelrohre entsprechen.

5. Durch das Verfahren gemäß den Ansprüchen 1 bis 4 hergestellte Treibladung mit einer Anzahl dicht und parallel gepackter Ein- und Mehrlochstäben (1) von rohrförmiger Treibladung mit inneren Verbrennungskanälen (2) von im Verhältnis zum Kanaldurchmesser großer Länge, wobei jeder rohrförmige Treibmittelstab in einem Abstand, der zwischen 10 und 100 Mal dem Kanaldurchmesser entspricht, mit Perforationen (3) versehen ist, die alle Verbrennungskanäle (2) des Treibmittelrohres abdecken, wobei die Perforationen ohne Entfernen von Treibladungsmaterial ausgebildet werden, dadurch gekennzeichnet, daß die Perforationen (3) quer zu den Treibmittelrohren und mit einer so großen Breite, daß sie sich durch sämtliche longitudinalen Verbrennungskanäle in dem Treibmittelrohr erstrecken, und mit einer bestimmten unversehrten Treibmittelmenge (4, 5) an beiden Seiten der Perforationen ausgebührt sind.

Patentfamilie:
(Stand 26.2.92)

: SE 87-3247		870821
SE 8703247	A0	870821
NO 883714	A0	880819
FI 883849	A0	880819
EP 304100	A1	890222
AU 2111388	A1	890223
SE 8703247	A	890222
JP 1069588	A2	890315
FI 883849	A	890222
IL 87354	A0	890131
ZA 8805410	A	890426
PT 88299	A	880901
NO 883714	A	890222
SE 461094	B	900108
US 4911077	A	900327
SE 461094	C	900517
AU 606733	B2	910214

Fig. 1

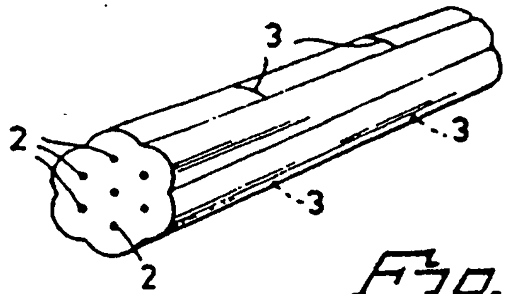

Fig. 2

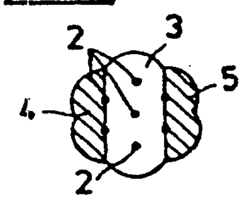

Fig. 3

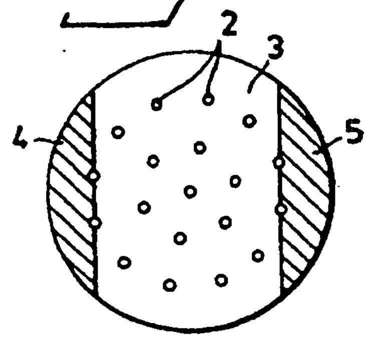

Fig. 4

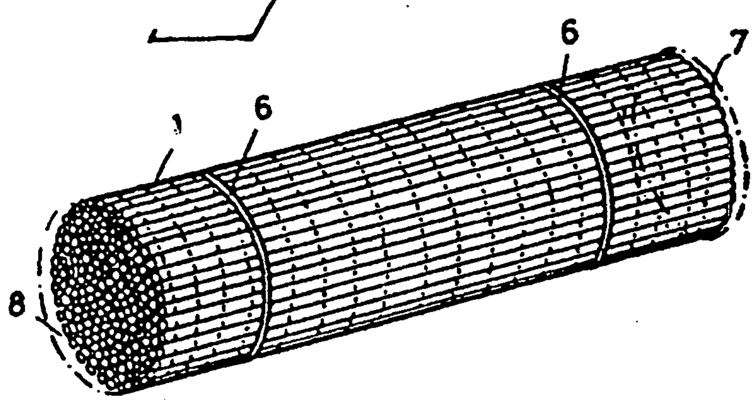

Fig. 5